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14. ABSTRACT
An optically activated 10 kV pulser was designed to provide low jitter, long life, reliable triggering of ignitrons, trigatron, or midplane triggered spark gaps in high voltage electrically noisy environments. For midplane triggered spark gaps, a step-up transformer is also required. The input to a fibre optic cable is a 9.5 watt injection laser diode. The pulser detects and amplifies the fibre optic cable output to 10 kV.

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LIGHT ACTIVATED 10 KV LOW JITTER PULSER*

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ABSTRACT

An optically activated 10 kV pulser was designed to provide low jitter, long life, reliable triggering of ignitrons, trigatron, or midplane triggered spark gaps in high voltage electrically noisy environments. For midplane triggered spark gaps, a step-up transformer is also required. The input to a fibre optic cable is a 9.5 watt injection laser diode. The pulser detects and amplifies the fibre optic cable output to 10 kV.

I. Introduction

The development of this pulser is intended to bridge the gap between inexpensive, relatively slow rise time, large jitter, sometimes short lived pulsers and the expensive fast rise time, low jitter, also short lived pulsers.

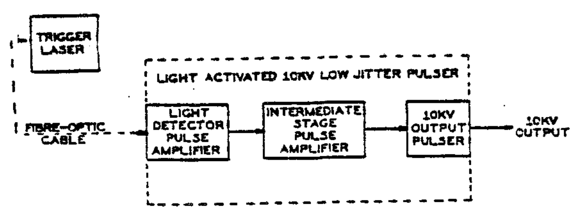
II. Design

The Light Activated 10 kV Low Jitter Pulser basic design consists of a Light Detector- Pulse Amplifier, an Intermediate Stage Pulse Amplifier, and a Krytron 10 kV Output Pulser. (See Fig. 1-Basic Block Diagram.)

The Light Detector-Pulse Amplifier consists of a photo diode, emitter follower and avalanche transistor.

The Intermediate Stage Pulse Amplifier is a twenty stage SCR Marx generator circuit.

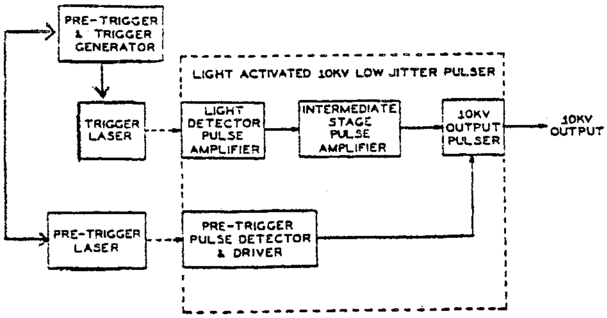
The Krytron 10 kV output pulser is a two stage modified Krytron tube Marx generator circuit. The modification to this tube consists of an elongated glass envelope ≈ 2.25" instead of the standard 0.85" for a KN-4 E. G. & G. Krytron tube. The increased glass envelope length provides for more gas thus increasing anticipated lifetime of the tube. In order to decrease the jitter of the tube, the keep alive element of the tube is pulsed with a current ≈ 100 times the normal keep alive current for one millisecond prior to the triggering of the grid of the tube. (See Fig. 2-Modified Block Diagram.)



BASIC BLOCK DIAGRAM

FIGURE 1

*Work performed under the auspices of the USDOE.



MODIFIED BLOCK DIAGRAM

FIGURE 2

III. Test

Light Detector-Pulse Amplifier. This circuit provides a 120 volt output pulse with ≤ 1 nanosecond rise time, 8 nanoseconds delay time and negligible jitter for triggering the Intermediate Stage Pulse Amplifier. This pulse will be used as a reference for measuring delays of the succeeding circuits. This pulse can be used as a synchronizing pulse for triggering scopes, etc.

Intermediate stage pulse amplifier. This circuit provides a 1400 volt output pulse with an 8 nanosecond rise time, 15 nanoseconds delay time and negligible jitter.

Krytron 10 kV Output Pulser. This circuit provides a 10 kilovolt output pulse with a 5 nanosecond rise time, 35 nanoseconds delay time, and 2 nanoseconds jitter.

The complete Light Activated 10 kV Low Jitter Pulser provides a 10 kilovolt output pulse with a 5 nanosecond rise time, 50 nanoseconds delay from the reference pulse or 58 nanoseconds delay from the light pulse, and 2 nanoseconds jitter.

IV. Future Experiments

Life testing of the present circuitry is yet to be performed. As a means of obtaining the best possible pulser with today's available technology designs of the following pulsers will also be built and tested.

1. Hydrogen Thyratron 10 kV Output Pulser (using an E. G. & G. HY-8 hydrogen thyratron)
2. SCR 10 kV Output Pulser (using A. E. I. Semiconductor XT 2105-1401 pulse thyristors)
3. RBDT 10 kV Output Pulser (using Westinghouse T40R102204 reverse bias diode thyristors)

An interest in the possible use of LASCR's has determined, through conversations with Lou Lowry at Westinghouse, that such a device is not yet available even experimentally which can be triggered with less than approximately 10 millijoules of light for a 1kV device. For a 10 kV pulser 10 LASCR's would therefore require 100 millijoules of light for triggering.

V. Acknowledgements

Discussions with Bill Nunnally and Jim Sarjeant at LASL have been most helpful in the design and testing of this pulser. Information concerning the modified Krytron tube and the method for decreasing its jitter have been provided by Spencer Merg of E. G. & G. and Jim Sarjeant at LASL.